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Potentiality of Jackfruit Seeds as a Nutritious Substitute for the Development of Ethnic Desserts

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ABSTRACT: The article discusses the potentialiating of using jackfruit seeds as a source of nutrition and as a substitute for flour in sweets and confectioneries. Jackfruit (*Artocarpus heterophyllus*) is an underutilized food source, belongs to moracea family and is native of Brazil. The jackfruit seeds are a significant source of nourishment, making up to 10-15% of the fruit's weight, but are often wasted due to challenges in processing and storage. The seeds can be roasted and ground into a powder that can be used as a substitute for flour in food industries. While the importance of desserts in a meal may vary among individuals, ethnicity, and cultures, they undeniably play a multifaceted role in enhancing the overall dining experience, adding sweetness, variety, and a sense of celebration to the table. *Ada Pradhaman* and *Paalada* is from Kerala cuisine and are the ethnic desserts made commonly on Onam and special occasions. In this study, three different processing treatments: Boiling and grinding, Drying and powdering, and flaking and two cooking methods were used to prepare the jackfruit seed base for this ethnic dessert mix. The treatment $v_1p_2c_1$ and $v_2p_2c_1$ samples from the *varikka* and *koozha* cultivars, respectively, had the highest scores in terms of appearance (8, 8.4), texture (8, 8.5), taste (7.9, 8.4), aroma (7.6, 8.3), mouthfeel (7.8, 8.3), and overall acceptability (7.9, 8.4).

Keywords: Jackfruit seeds, Ethnic, Dessert base, functional, sensory parameters.

INTRODUCTION

The main thrust on studies in recent years has been on finding unappreciated crops that could be beneficial for human consumption. Native to South and Southeast Asia, jackfruit is grown in lowlands and was first produced in the Western Ghats' dense forests of India. Being recognized as the state fruit of Kerala, it has gained enormous market potential and unexplored growth prospects. Carbohydrate, proteins, potassium, calcium, iron, and vitamins A, B, and C are all abundant in this nutrient-dense fruit. The jackfruit fruit varieties are still neglected and ought to get funding that is required for further research and development. The scattered nature of the jackfruit in market, despite of its abundance, enormous potential, and limitless advantages, presents numerous prospects for growth and expansion both in India and globally through the introduction of novel and unexplored products with tremendous revenue potential and scalability (Khan *et al.,* 2023). Desserts add some variety to the meals while still emphasising the need of eating a well-balanced diet rich in whole grains, vegetables, and protein. According to studies, foods with a high natural percentage of carbs aid in the production of neurotransmitters (such as serotonin) that contribute to general emotional well-being in the brain and body. *Ada Pradhaman* is one of the richest *payasam* and a must serve in Onam *Sadya*. '*Ada*' is rice flour flakes and '*Pradhaman*' is *payasam/kheer* so it means *payasam* made with rice flakes. It is made by cooking rice *ada* with jaggery syrup, coconut milk and flavoured with cardamom and nuts. On the other hand, for *Palada,* the rice flakes are cooked with sugar and cow's milk. The utilization of seed from jackfruit as a replacement for starch flour has come to many attentions from researchers. Jackfruit is considered to be a potential source for starch (Waghmare *et al.,* 2019). Jackfruit seed is considered to be a cheap source for carbohydrate, as the seed majorly contains 60–80% dry matter basis in which it comprises 8–15% of the fruit weight. Starch from jackfruit has great potential for various applications due to its unique structure and functional features (Suzihaque *et al.,* 2022). With this background, the present study aimed at developing an ethnic dessert base from the seeds of jackfruit and thereby assessing its organoleptic and functional parameters.

MATERIALS AND METHODS

The common cultivars of jackfruit *varikka* (v_1) and *koozha* (v_2) were selected for the study. Jackfruits were

procured directly from the farmers and also from the local markets.

Preparation of ethnic dessert base. The seeds were separated from the fruits of both cultivars and cleaned manually by removing the seed coat (white arils) and peeling off the testa (brown spermoderm) before processing, using a stainless-steel knife. The seeds were rinsed with running water. The pre-processing for the dessert base was done using three treatments. p_1 – Boiling and grinding, p_2 – Drying and powdering, p_3 – Flaking (using a flaker machine – 2mm)

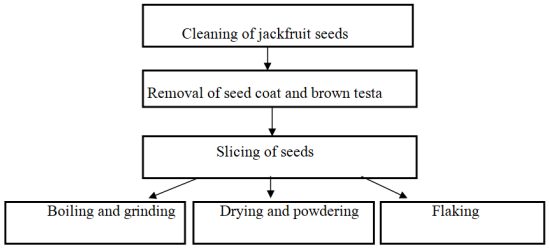

Fig. 1. Processing of jackfruit seeds for dessert base preparation.

For p_1, the pre-processed jackfruit seeds which had been coarsely chopped and their size reduced were cooked for five to ten minutes before being ground into a paste with enough water. In p_2, the anti-nutritional elements that inhibit nutrient absorption and sensory characteristics were eliminated by gelatinizing the jackfruit seeds for ten minutes. The extra water was removed after gelatinization. After that, the seeds were finely chopped and tray dried for two hours at 70°C in cabinet dryers. Both the temperature and the time were standardized. The seeds were allowed to cool and then ground into a fine powder after tray drying.

Processing of ethnic dessert base (*Ada*). The base (*Ada*) for the ethnic dessert from jackfruit seed was made with the treatments (p_1 & p_2) that were obtained from the earlier mentioned processing methods. The base (*Ada*) was cooked using the following techniques: c_1: steaming, c_2: boiling.

In order to get the required consistency for c_1 and c_2, water was mixed with the base material. After that, the batter was spread over butter paper, rolled, and steamed or boiled for ten minutes, accordingly. Following cooling, the *Ada* were separated from the butter paper, diced into tiny (6 mm) pieces, and dried until the required moisture content was obtained. The *Adas* obtained from p_3 was directly used for preparing instant dessert mix.

Fig. 2. JSBM (base material prepared from jackfruit seeds) developed under different treatments.

Assessment of Functional quality of the base (*Ada*) developed from jackfruit seeds.

Food quality is greatly influenced by its functional qualities. Food components, in particular carbohydrates, proteins, fats and oils, moisture, fiber, and ash, together with their structural variations, affect how foods and flour's function (Awuchi, 2017). Functional qualities such as yield ratio, rehydration ratio, solubility index of the jackfruit seed-based dessert base was evaluated using the following methods.

Yield ratio. Yield ratio of the Jackfruit seed-based dessert base was analyzed using the formula. (Krishnaja, 2014)

$$\text{Yield ratio} = \frac{\text{Final weight of product (g)}}{\text{Weight of the ingredients (g)}}$$

Rehydration ratio. The rehydration ratio of jackfruit seed-based dessert base was computed by taking ten grams of the sample, combined with 100 milliliters of distilled water, stirred, and allowed to stand for five minutes. The contents were filtered using paper filters.

Using the formula (Ranganna, 1986), the rehydration ratio was calculated after the rehydrated sample was weighed.

Solubility index. The solubility index was calculated using the methodology of Anderson (1969). After one gram of material was suspended in ten milliliters of distilled water in a centrifuge tube, it was centrifuged for ten minutes at 3000 rpm for 30 minutes at room temperature with moderate stirring in between. After being weighed out, the supernatant was placed in a petri dish and dried at 110°C in a hot air oven. The weight of the dry soluble solids in supernatant, or g/g, is the solubility index. It is represented as a percentage of the initial sample weight.

The percentage solubility of the supernatant was calculated by

$$\text{Solubility} = \frac{\text{Weight of dry solids}}{\text{Volume of supernatant}} \times \frac{100}{\text{Weight of sample}}$$

Sensory evaluation of the dessert base. The organoleptic evaluation of the dessert base was performed by 15 semi-trained pane lists. The desserts were made by cooking 15g of the developed ethnic dessert bases (*ada)* with 20g of milk powder in 200mlwater and 5 g of sugar. The sensory attributes of the jackfruit seed-based dessert base, such as their color and appearance, taste, texture, flavour, mouthfeel and overall acceptability, are scored using a 9-point hedonic scale. The difference in the scores was analyzed using Kruskal –Wallis test.

Statistical Analysis. For the study, the data from multiple assessments were performed using KAU-GRAPES (online statistical analysis tool) for Completely Randomized Design (CRD) for functional quality and nutrient analysis of the ethnic dessert base. The Kruskal-Wallis test was used to determine the sensory evaluation scores of the dessert base based on the observed mean values.

RESULT AND DISCUSSION

Preparation of ethnic dessert base. The jackfruit seeds were finely diced, boiled for five to ten minutes, and ground into a paste using enough water for p_1.Jackfruit seeds were gelatinized for 10 minutes, drained, finely diced, and dried at 70◦C for 2 hours, ensuring nutrient absorption and sensory parameters, then ground to fine powder. The seeds were soaked, dried, roasted, and flaked using a flaker machine. The jackfruit seed flakes were directly used in developing instant dessert mix. The boiling time and temperature were standardized for each treatment. The treatment involving 30 minutes of drying and 10 minutes of roasting was identified to be the most suitable.

Processing of ethnic dessert base (*Ada*). The base material obtained from p_1 and p_2 was blended with the right quantity water to bring the batter to the desired consistency for c_1 (Steaming) and c_2 (Boiling), which were then spread over thin butter paper, rolled, and steamed/boiled for 10 minutes. *Ada* base from butter paper, was separated and dehydrated to the required moisture content, then used to prepare instant dessert mix, following standardization of dehydration temperature and time of 60◦C for 2 hours. The base from $v_1p_1c_1$ (*varikka* × Boiling and grinding × Steaming) and $v_2p_1c_1$ (*koozha* × Boiling and grinding × Steaming) got gelatinized after cooking. The batter leached into boiling water and fell into bits. As for $v_1p_2c_1$ (*varikka* × Drying and powdering × Steaming) and $v_2p_2c_1$ (*koozha* × Drying and powdering × Steaming), *ada* sheets were obtained in less than 5 minutes when the batter was spread over and steamed. *Ada* sheets were dehydrated for 2 hours in a cabinet drier at 60°C, then packed in polypropylene and stored. Starch granules thickened and lumps formed in $v_1p_2c_2$ and $v_2p_2c_2$. The jackfruit seed lacks gluten which is a binding agent of flours used in confectionaries (Akter and Haque 2018). As for v_1p_3 (*varikka* × Flaking) and v_2p_3 (*koozha* × Flaking), seeds were flaked using a machine, adjusting the rotator to 2 mm. Despite multiple trials, the end product resembled thin, dry rice flakes, lacking traditional *ada* base consistency.

Functional qualities of the base (*Ada*) developed from jackfruit seeds. Functional properties including Yield ratio, Rehydration ratio and Solubility index, of the dessert base were analyzed and the results are depicted in the following Table 1.

Table 1: Functional qualities of the base (*Ada*) developed from jackfruit seeds under different treatments.

Treatments	Yield ratio	Rehydration ratio	Solubility index
$v_1p_1c_1$	1.147^{b}	1.173^{a}	0.9421^{bc}
$v_2p_1c_1$	1.210^{a}	1.233^{a}	0.9486^{bc}
$v_1p_1c_2$	1.230^{a}	1.127^{ab}	0.9277^{c}
$v_2p_1c_2$	1.247^{a}	1.103^{ab}	0.9491^{bc}
$v_1p_2c_1$	0.557^{d}	0.387^{d}	0.9538^{b}
$v_2p_2c_1$	0.580^{d}	0.453^{d}	0.8970^{d}
$v_1p_2c_2$	0.593^{d}	1.033^{bc}	0.9275^{c}
$v_2p_2c_2$	0.587^{d}	0.917^{c}	0.9345^{bc}
v_1p_3	0.380^{e}	1.023^{bc}	0.9575^{ab}
v_2p_3	0.430^{e}	1.030^{bc}	0.9499^{bc}
c	0.377^{d}	1.000^{c}	0.9818^{a}
±SE(m)	0.02	0.046	0.856
CV (%)	4.199	8.981	1.573

Values are means of triplicates

From the result it was observed that the treatment $v_2p_1c_2$ (1.247^{a}), $v_1p_1c_2$ (1.230^{a}) and $v_2p_1c_1$ (1.210^{a}) had the highest yield ratio than v_1p_3. The removal of brown spermoderm, white arils, and due to processing loss, the weight of the jack seeds was decreased (Islam *et al.,* 2015). The variation in the yield ratio of the jackfruit based *Ada* of the present study might be the reflection of the pre-processing and processing losses it was subjected to in the current study, rehydration ratio was observed highest for $v_1p_1c_1$ (1.173^{a}), $v_2p_1c_1$ (1.233^{a}), $v_1p_1c_2$ (1.127^{ab}) and $v_2p_1c_2$ (1.103^{ab}) treatments. Sreejaya *et al.* (2023) reported rehydration ratio of jackfruit seed flour as 0.364 (*koozha*) and 0.359 (*varikka*). The jackfruit seed-based dessert base had the highest rehydration ratio than jackfruit seed flour. This might be attributed to the different processing treatments of the base material. The solubility index value ranged from 0.89 – 0.98. Control (0.9818^{a}) had more solubility index than other treatments. A studyconducted by Islam *et al.* (2015) reported that the jackfruit seed-based flour had solubility of 2.31% which is higher than the obtained value.

Sensory parameters

Color and appearance. Color and appearance are the primary and most significant factors in determining the food's safety and quality. Food that doesn't look good will be turned down by customers. From the above table it is clear that $v_2p_2c_1$ (8.4) from *koozha* cultivar and $v_1p_2c_1$ (7.9) from *varikka* cultivar obtained highest score which shows these two treatments are on par with control (7.7).

Texture. Mouthfeel, masticatory qualities, residual qualities, and even a food's visual and auditory qualities are all included in its texture. The table shows that there is no significant difference between the treatments. From the result it was evident that the treatment $v_2p_2c_1$ (8.5) and $v_1p_2c_1$ (8.0) had highest score. The least preferred treatment was $v_2p_2c_2$ with a score of 6.2.

Aroma. The consumer uses aroma to determine whether food is authentic. From the table, it is clear that there is no significant difference between the treatments. From the table it is evident that the treatment $v_2p_2c_1$ (8.4) and $v_1p_2c_1$ (7.9) had got the highest score while the treatment $v_1p_2c_2$ (5.4) got the least rank.

Taste. Taste buds, which are taste receptors on the tongue, receive taste impulses, which converts taste perception into a chemical sense. The table shows that the treatments are significantly different. The treatment $v_2p_2c_1$ (8.3) and $v_1p_2c_1$ (7.6) has got the highest score for the attribute of taste. The least ranked treatment was $v_1p_2c_2$ (5.6).

Mouthfeel. The mouthfeel of a substance is the sensation it gives on the mouth after ingestion. From the table, it is clear that there is no significant difference between the treatments. The treatment $v_2p_2c_1$ (8.3) and $v_1p_2c_1$ (7.8) had got the highest score, they are on par with each other for the mouthfeel attribute. The least scored treatment was $v_1p_2c_2$ (5.6) and $v_2p_2c_2$ (5.6), they were on par with the $v_1p_1c_1$ (6.4), $v_2p_1c_1$ (6.3), $v_1p_1c_2$ (6), $v_2p_1c_2$ (6.2), v_1p_3 (6.5), v_2p_3 (6.4) treatments.

Overall acceptability. Overall Acceptability of a product can be judged through their color, Appearance, Taste, Texture and Flavor of the product. From the statistical analysis, it was analysed that there is no significant difference between the treatments. From the result, it was analyzed that the treatment $v_2p_2c_1$ (8.4) from *koozha* cultivar and $v_1p_2c_1$ (7.9) from *varikka* cultivar were superior in overall acceptability and showed maximum acceptance. While the treatment $v_1p_2c_2$ (5.6) had got the least score among all.

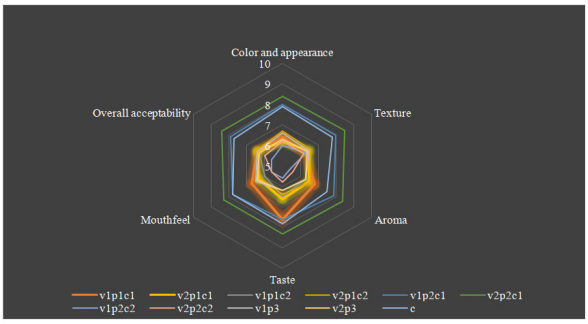

Fig. 3. Sensory evaluation of dessert base.

CONCLUSIONS

The research was aimed to evaluate the functional qualities and the sensory characteristics of the jackfruit seed-based dessert mix. The *payasam* has been a delicacy with flowable consistency and possesses pleasant caramel taste moreover it's part of the culture in every celebration. Jackfruit seed has been used as a starch substitute for many confectioneries. Incorporating jackfruit seed flour for developing the ethnic dessert base provides a gluten free meal packed with high nutrients. The demand for delicious, nutrient-dense food that is also simple to make and eat is rising. The association between diet and disease is causing consumers to choose foods that are high in nutrients. Jackfruit seed can be used to develop value added novel products which can help to enhance the nutritional quality of food for human consumption. The sensory evaluation and functional qualities depicted that the $v_1p_2c_1$ and $v_2p_2c_1$ samples from the *varikka* and *koozha* cultivars, respectively, had the highest scores in terms of appearance, texture, taste, aroma, mouthfeel, overall acceptability, rehydration ratio, solubility index, and yield ratio. The results showed that jackfruit seed-based dessert base can be used as the main ingredient to develop dessert mixes.

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